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# Students' Problem Solving Ability Based on the Fraction Concept Mastery in the PBL Model

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## Abstract

This study aims to determine students' problem solving abilities based on the mastery of the concept of fractions in the PBL model. Mixed method with sequential explanatory design was used in this research. This research was conducted in class V SD Negeri 1 Cikeduk Cirebon Regency in 2018/2019. The Data obtained by tests, interviews, and observation sheets. Qualitative learning is assessed from the planning, implementation, and assessment stages. The test results of students' problem solving abilities were analyzed quantitatively by one sample t-test and classical completeness test. Students were grouped based on their concept mastery which consists of the high concept mastery category (PKT), the medium concept mastery category (PKS), and the low concept mastery category (PKR) and two subjects from each concept mastery category were chosen to be interviewed. The results showed that; (1) students' problem solving skills achieve mastery in the PBL model; (2) Increased students' concept mastery ability; (3) Students' problem solving skills in students with high concept mastery are able to master the problem solving steps of Polya-Schoenfeld theory. (4) Students' problem solving skills in students whose mastery is able to master three indicators of problem solving from four indicators; and (5) students' problem solving skills in students with low concept mastery only mastered two indicators, and the results of the final answers were not right. It can be concluded that there is an improvement of student learning outcomes in solving problems based on concepts mastery in the PBL model.



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## INTRODUCTION

Problem solving is an important component of the mathematics curriculum which has a core of mathematical activity, thus problem solving skills among students need attention in teaching and learning proces. In line with Misu (2014), problem solving is part of a very important mathematics curriculum because in the process of learning and solving, students use the knowledge and skills they have to implement problem solving. Solving problems in teaching and learning activities is one of the goals of the Ministry of National Education Regulation No. 22/2006 on Standards Content (SI), mathematics learning is solving problems that include the ability to understand problems, design mathematical models, solve mathematical models, and interpret the solutions obtained.

The ability to solve problems is the main goal in learning mathematics, therefore the ability to solve problems should be given, trained, and accustomed to students as early as possible. Through problem solving is expected to develop students' thinking skills. Similarly, Anderson (2009) states that problem solving is a life skill that involves the process of analyzing, interpreting, reasoning, predicting, evaluating and reflecting. Provision of problems that have several different ways of solving are important in the ability of students' concepts and provide meaningful learning for students (Bingolbali: 2011). In this study, researchers used the four steps of Polya's theory (1973) in solving problem solving, namely: 1) understanding the problem, 2) devising a plan (obtain eventually a plan of the solution), 3) carrying out the plan (carry out your plan), and 4) looking back (examine the solution obtained).

According to Sopia *et al*. (2015) that basic mathematics is mathematics that is taught at the level of primary education and secondary education which aims to develop abilities and shape students' personalities through mathematics. Samo (2009) states mathematics is an important science to learn and as the basis of all sciences. Mathematics is the science of logic in the form of structures, targets, concepts which are divided into several branches, and one of the means of thinking in order to develop and develop ways of thinking logically, systematically and critically. Torio (2015) also states that one of the goals in learning mathematics is to make students effective problem solvers.

The low ability of problem solving is caused by many factors, one of the factors is the lack of trained in solving problems related to problem solving in the form of daily life story. Another problem that makes students unable to achieve mastery in learning is that teachers still assume students have the same ability to comprehend the lessons and solve mathematical problems (Ovan & Nugroho, 2017). The low concepts mastery of the students also influences the success of problem solving abilities. The concepts that are well accepted and understood by students will guide students to solve problems systematically and in a structured way. If students are trained to solve problems, the students will be able to make decisions, because these students have been skilled at gathering relevant information, analyzing information and re-examining how necessary the results they have obtained.

Paying attention to what students will get by learning to solve problems is a very important part in learning mathematics. According to Albert & Kim (2013) states that students can develop their creativity by engaging in problem solving activities. In addition Schoenfeld (2002) states that students' success in solving problems is not only supported by students' cognitive abilities, also students' self control in the problem solving process. According to Rahman (2008) each student's personal characteristics are factors that also determine the success of learning in addition to other factors. Dimensions of individual differences include intelligence, logical thinking ability, creativity, cognitive style, personality, values, attitudes, and interests (Ulya, 2015).

In the problem solving process there are factors that support students' success in solving problems, including: (1) concentration, (2) attitudes toward mathematics, (3) motivation for achievement, (4) self-esteem (5) self-confidence

(Pimta *et al*, 2009). Marisanita (Saironi: 2017) states that for learning outcomes to work well, an appropriate method or strategy is needed in the learning process carried out by students and teachers. To anticipate the problem is sustainable, it is necessary to find the appropriate learning model, so that it can increase student activity in learning mathematics.

The learning model is believed to increase the effectiveness of learning. This was confirmed by research by Purnomo, Kartono and Widowati (2015), Adiastuty, Rachmad, and Masrukan (2012), and Ulya, Masrukan and Kartono (2012) which concluded that students' problem solving skills following learning with a learning model were better than students who learn by expository. Learning models that are able to facilitate students' active learning, one of them is a learning model that is suitable for the purpose of learning problem solving is PBL learning model. Hmelo-Silver (2004) states that PBL is a learning model where students learn through a problem to solve a problem. Sinambela (2008) PBL is a problem-based learning consisting of a small group of students and guided by a tutor. According to Yew *et al.* (2011) PBL learning is student-centered, so it is responsible for their own learning.

PBL learning can improve students' mathematical problem solving abilities (Sudarman, 2007). PBL is a mathematical learning model that emphasizes problem solving in the learning process PBL is a process as well as an integrated curriculum in learning. Through PBL, students can independently learn to identify problems where knowledge is needed again to deal with new problem states (Boyle, 1999). In addition, problem solving can encourage creativity and develop writing and verbal skills that are part of the mathematical application process (Pugalee, 2004). Karaduman (2013) said that the learning objectives of PBL make students become independent in learning, have the ability to solve problems, and students can face problems that might occur in everyday life.

That PBL method of teaching is more effective for teaching mathematics. By adopting PBL methods in teaching mathematics teacher can create a number of creative thinkers, critical dicision makers, problem solvers which are very much needed for the competitive world (Padmavathy, 2013). The results of this study indicate that PBL teaching methods are more effective for teaching mathematics. Through PBL methods in teaching mathematics, teachers can create a number of creative thinkers, critical decision making, problem solving which is very much needed for a competitive world.

PBL is designed to help teachers get as much information as possible to students through a problem. PBL helps students to develop thinking skills and problem solving skills, study adults and become independent learners. Already in ancient times under Socrates it was well-known that the putative ignoramus finds gradual solutions to complex problems strating from a question. Thisability is also of crucial importance in today's society's knowledge and information. This style of teaching is called "Problem-based learning (PBL)" (Nicole, 2010). With PBL teachers can make students to find problems independently and sustainably. In this method, students are expected to get memorable experiences when finding solutions to the problems encountered.

The thinking ability of learners can also be developed by applying the Problem-Based Learning (PBL) model (Nuswowati, 2017). Thus, PBL is expected to be able to develop students' thinking abilities in the PBL learning process which will trigger the development of students' thinking abilities. In addition, based on the opinion of Sungur (2006) said that the PBL model can lead to the ability to think critically and new knowledge for the long term. PBL can improve students 'scientific attitudes and critical thinking skills as a result of research conducted by Astika (Irfan & Udi, 2018) PBL improves students' scientific attitude and critical thinking skills. So to improve students' critical thinking skills and scientific attitude, we can apply PBL in the learning process.

The aims of this research are to find out students 'problem solving abilities in terms of mastery of fraction concepts in the PBL model, students' problem solving abilities achieve

mastery in PBL models, increasing students 'concept mastery ability, students' problem solving abilities in students with high concept mastery (PKT), ability problem solving of students in students whose mastery of the concept is (PKS), and the ability of problem solving of students of students whose mastery of concepts is low (PKR).

## METHODS

Mixed method with sequential explanatory design was used in this research. The sequential explanatory model is a combination research method that combines quantitative and qualitative research methods sequentially, where in the first stage the research is conducted quantitative methods and the second stage is carried out with qualitative methods (Sugiyono, 2017). The implementation of sequential explanatory design starts from the collection and analysis of quantitative data followed by the collection and analysis of qualitative data that is built based on the initial results of quantitative data (Creswell, 2013).

The populations in this research were fifth grade students of SD Negeri 1 Cikeduk in the 2018/2019 school year. Purposive sampling was used in this research. Data in this study were test of problem solving ability, test of cognitive that assesses attention problem-solving ability (TKPM) answer sheets, student fraction mastery test concepts, and interviews. Technique of collection the data in this study were observation techniques, documentation, problem solving ability test, fractional concept mastery test and interview. Research subject is based on the results of the mastery test on the concept of fractions. Accordin to these tests, students are divided into three categories, namely high concept mastery (PKT) students who have mastery of concepts with a score of 90-100, moderate concept mastery (PKS) students who have mastery of concepts with a score of 70-80, and low concept mastery (PKR) students who have mastery of concepts with a score below the KKM value of 70.

Learning using the PBL model is said to be good if: (1) learning planning has a valid set of tools. (2) the implementation of learning is indicated by the level of implementation of the learning process carried out can run with a minimum of good category. (3) the assessment of learning outcomes is seen from the effectiveness of PBL model learning shown by: (a) the average value of students' problem solving abilities in learning with PBL models surpassing KKM of problem solving abilities, 70 (b) the proportion of students completeness being subjected to PBL is more of 75% (c) an increase in mastery of concepts and the ability to solve students' problems after treatment.

## RESULTS AND DISCUSSION

### Mastery Learning PBL Model

The completeness of mathematics learning using PBL models is shown in the following three stages: (1) the planning stage, at this stages the learning tools and research instruments that have been prepared are valid. This is based on the results of the assessment of the validator obtained the average value for the syllabus, lesson plan (RPP), test of problem solving ability (TKPM), observation sheets, and interview guidelines included in the very good category. Thus, it can be concluded that the learning tools and research instruments compiled are valid and suitable for use in research; (2) the implementation phase, at the stage of the implementation of learning is in the very good category. It can be seen in the average percentage of the results of the implementation of learning in the excellent category; and (3) the stages of assessment of learning outcomes; it can be seen from the assessment of mathematics learning outcomes with the PBL model taking place effectively which meets the one sample t-test and classical completeness test.

Based on data analyze of normality and homogeneity in this study indicate that the final data of the two samples are normally distributed and there is no significant difference in variance in class fifth. Furthermore, it is measured based on a hypothesis test: (1) average test, the average test obtained significance value ($\alpha$) = 0.000 < 0.05, then $H_0$ is rejected. The average value of the

problem solving ability of fifth grade students reaches a minimum completeness of 70; (2) classical completeness test, this test is based on the results of the problem solving ability test of the final students of fifth grade, obtained data that students who reach KKM ($x$) are 30 students from the number of students in fifth grade ($n$) as many as 35 students. Based on the data obtained, the value of $z$ arithmetic = 2.161. The area of rejection of $H_0$ is $Z_{count} \geq Z_{(0.5-\alpha)}$ . The z value of the standard normal distribution list is $Z_{(0.45)}$ = 1.64. Because 2.161 > 1.64, $H_0$ is rejected and $H_1$ is accepted, meaning that the ability of problem solving and mastery of the concept of fraction of fifth grade students in the PBL model has reached 75% classical completeness. The results of TKPM and the concept mastery test for fractions of class fifth SD Negeri 1 Cikeduk Cirebon Regency can be seen in Table 1 below:

**Table 1**. TKPM Results and Concept Mastery Tests

| Test form | Number of students | Maximum score | Minimum score |
|---|---|---|---|
| Assesment (PG) | 35 | 100 | 30 |
| TKPM (Description) | 35 | 100 | 68 |

Based on Table 1 it shows that students who get a maximum score of concept mastery and TKPM are 100 while the minimum score of concept mastery is 30 and TKPM 68. Furthermore, it is grouped into three groups, namely (PKT), (PKS), (PKR), then selected 2 students from each group to proceed at the interview stage as subjects. Before analyzing students' problem solving abilities in terms of mastery of concepts, the researcher examine the normality and homogeneity data of each concept mastery group. The results of the normality and homogeneity test of each concept mastery group showed the data were normally distributed and there was no difference in variance.

**Concept Mastery Ability**

According to TKPM results, PKT students had the highest average scores compared to the students in the posttest scores. In the step of understanding the problem (understanding the problem), students can write what is known and asked of the problem correctly. The steps to devising a plan (obtain eventually a plan of the solution) are well done by students. Students can write a picture of the problem and estimate a solution strategy that is in accordance with the problem. In the third step, carrying out the plan is done by students appropriately and systematically. Students can carry out problem solving based on a plan and communicate conclusions precisely. In the step of looking back (examine the solution obtained), students are able to examine problems and present extensions appropriately. The students' work result from PKT level is preseted in Figure 1.

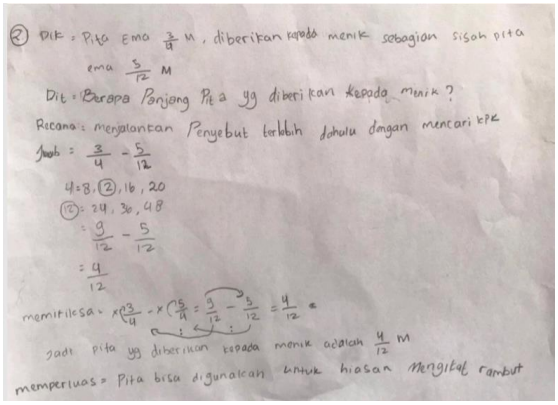


**Figure 1**. Example of The Work Results of PKT students

The ability to master concepts in PKS students, based on the results of TKPM is quite good, in the first step, understanding the problem, students can write what is known and asked of the problem correctly. The second step is to devising a plan (obtain eventually a plan of the solution), students can write a picture of the problem and estimate a heuristics strategy that fits the problem. In the third step, carrying out the plan students can carry out problem solving based on the plan and communicate conclusions precisely. In the fourth step, looking back (examine the solution obtained), students have examined the problem but have not been able to present it properly. In this step students were improved, because in the pretest many students do not check and expand the answers. The students' work result from PKS level is preseted in Figure 2.

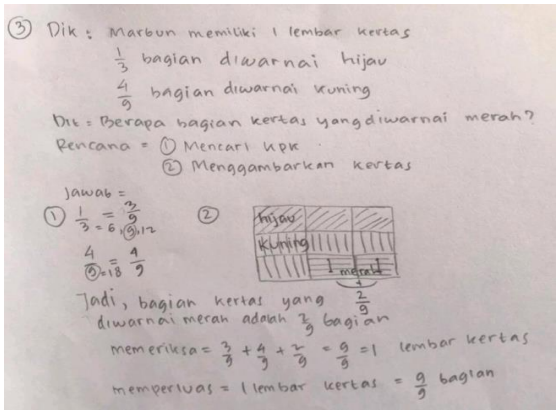


**Figure 2**. Example of The Work Results of PKS Students

The ability to master concepts in PKR students, based on TKPM results is not good. PKR students also experienced a significant increase in problem solving abilities. Students are able to write what is known and asked of the problem correctly in the step of understanding the problem (understanding the problem). The second step is to devising a plan (obtain eventually a plan of the solution), students can write a picture of the problem and estimate the heuristics strategy well. In the third step, carrying out the plan students are still having trouble carrying out problem solving based on the plan and communicating conclusions so that the results of the answers are not right. In the step of looking back (examine the solution obtained), students have not been able to examine the problem and present the expansion appropriately. Checked the problem but hasn't been able to present it properly. The students' work result from PKR level is preseted in Figure 3.

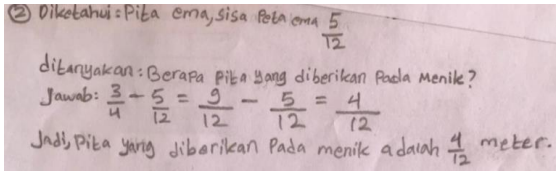


**Figure 3**. Example of The Work Results of PKR Students

The validity of the description of problem-solving abilities in terms of mastery of the concept of fractions is strengthened by conducting in-depth interviews with 6 selected research subjects. Each fraction mastery concept group was represented by 2 students as the research subjects.

**Problem Solving Capability Judging from Mastery of Concepts**

The problem solving ability of students can be seen from the mastery of students' concepts and it is described based on data from the results of tests of problem solving skills and the results of interviews. Interviews were conducted on six selected students, namely two students from (PKT) namely SP-21 and SP-15, two students from (PKS) namely SP-05 and SP-16, and two students from (PKR), namely SP-13 and SP-31. The answers from selected subjects is as follows; (1) indicators of understanding the problem, students are able to present problems by writing down known and asked questions; (2) indicators planning problem solving, SP-21 and SP-15, SP-05 and SP-16 are able to write plans to solve problems but SP-13 and SP-31 do not write plans; (3) indicators implement the completion and control plan, SP-13 and SP-31 do not carry out the settlement correctly; (4) checking and expanding indicators show that, SP-05 and SP-16 can only present checking indicators while SP-13 and SP-31 cannot present checking and expanding indicators.

Generally, based on the results of tests of problem solving skills and interviews, each subject has a varied characterization of problem solving abilities. Students on (PKT) have good problem solving skills. This is demonstrated by the ability to master good concepts students master the four indicators of problem-solving ability based on Polya-Schoenfeld theory, namely understanding the problem, devising a plan, carrying out the plan, and looking back. Furthermore, (PKS) is quite good enough where, students only master three of the four indicators based on Polya-Schoenfeld's theory namely understanding the problem, devising a plan, carrying out the plan, while the indicator looking back the student not yet proficient to present it. While students with (PKR), are not good in solving problem solving, the results presented are incorreect on the presentation of carrying out the

plan, students cannot write the resolution plan indicators and looking back indicators.

## CONCLUSION

Based on the results of the research, it can be concluded that the students' problem solving ability achieves completeness in the PBL model, increasing students' concept mastery ability, students 'problem solving skills in students with high concept mastery being able to master the problem solving steps of Polya-Schoenfeld theory well, students' problem solving abilities whose mastery is able to master three indicators of problem solving from four indicators; and students' problem solving skills in students with low concept mastery only mastered two indicators, and the final answer results were not yet right.

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